

Institution: Edinburgh Napier University		
Unit of Assessment: Unit of Assessment 3 – Allied Health Professions, Dentistry, Nursing and Pharmacy		
Title of case study: Reducing cardiovascular deaths through blood pressure telemonitoring in primary care		
Period when the underpinning research was undertaken: February 2008-July 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Janet Hanley	Role(s) (e.g. job title): Research Fellow (PI), NHS Associate Associate Professor (co-PI)	Period(s) employed by submitting HEI: January 2006-July 2012 February 2013-ongoing
Jenny Ure	Research Fellow	February 2008-December 2012
Period when the claimed impact occurred: February 2016-December 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words) Research at Edinburgh Napier University on home blood pressure (BP) telemonitoring in primary care has had significant national and international impact. Findings have improved hypertension management and reduced patients' risk of major cardiovascular events such as heart attack and stroke, whilst also reducing demand on primary care because fewer appointments have been needed. Offering a better method of BP monitoring, telemonitoring has been adopted by over 400 Scottish GP practices, reaching over 14,000 people (hypertensive patients) in Scotland, with a Scottish Government target of 20,000 patients by 2021. Internationally the research has influenced clinical guidance and services in the US, Canada, Europe, Asia and Japan. Additionally, an online tool is improving accuracy of screening for hypertension.		
2. Underpinning research (indicative maximum 500 words) High blood pressure (BP) (hypertension) is a major cause of death and disability, affecting 1.13billion people (1 in 4 adults) worldwide and responsible for 50% of heart attacks and strokes. Often without symptoms, it is known as the 'silent killer' with as many as 20% of those with hypertension undiagnosed or not treated to target. Hypertension places significant financial pressure on healthcare services, costing the National Health Service (NHS) in the UK up to GBP3billion annually. Clinical time is also heavily impacted. In Scotland, blood pressure checks account for 1.2million appointments annually for a population of 5.5million. With an ageing society these numbers will rise, presenting an urgent need for solutions to manage the epidemic of hypertension. Research by Dr Janet Hanley, Associate Professor at Edinburgh Napier University (ENU) has focused on facilitating BP measurement at home using technology to electronically share the readings with a nurse or doctor in primary care (telemonitoring). This addresses three key areas. 1) The need for more accurate and frequent BP readings, with in-clinic readings often subject to the 'white coat effect', 2) The need to improve patient engagement and understanding of their condition, 3) The reduced number of and shorter primary care appointments required. Dr Hanley has strong links to the NHS with a background in community nursing and service		

development. Supported at ENU by Dr Jenny Ure, key collaborators include University of Edinburgh and NHS Lothian.

BP Telemonitoring Trials

Dr Hanley led the randomised controlled trial and qualitative studies of BP telemonitoring [O1 O2, G1] which initiated the Telescot research programme, a major collaboration with NHS Lothian and the University of Edinburgh to advance the use of technology in healthcare. Of 401 participants, 200 monitored their BP at home and submitted results by text message to the practice via a secure website. After 6 months, the telemonitoring group showed lower readings of both systolic and diastolic BP, potentially reducing stroke by 15% and myocardial infarction by 10%. This outcome was subsequently replicated in two higher risk groups, those who had previous stroke or transient ischaemic attack (TIA) [O3] and those with type 2 diabetes [O4]. The embedded qualitative study revealed greater trust in home BP monitoring by both patients and healthcare professionals and demonstrated increased patient empowerment [O2]. A novel finding from this study was that professionals (mainly practice nurses) found logging on to the commercially supplied, secure web-based interface time consuming.

Health Service Redesign

In 2015, the Telescot collaboration, including Hanley, developed an initiative to encourage primary care practices and patients to engage in remote BP monitoring (Scale Up BP). A novel bridging system was developed to deliver BP telemonitoring reports to practices through their usual document management system. Seventy-five primary care practices enrolled 3,200 patients. Eight of these practices were evaluated, showing that both clinician and patient engagement were improved and that BP telemonitoring led to better management of High BP [O5].

Screening for hypertension

Dr Hanley worked as part of an international pooled data collaboration including University of Oxford, University of Cambridge, University of Warwick and University of Toronto. The study used trial data, office-based, and ambulatory BP measurements to develop an algorithm to identify those most likely to be misclassified by screening clinic BP measurement. Triage using the Predicting Out of Office Blood Pressure (PROOF-BP) algorithm would have reduced the need for ambulatory BP monitoring (uncomfortable and expensive) by 49% [O6].

3. References to the research (indicative maximum of six references)

All outputs O1-O6 have been published following rigorous peer-review.

[O1] McKinstry B, Hanley J, Wild S, Pagliari C, Paterson M, Lewis S, Krishan A, Stoddart A, Sheikh A, Padfield P (2013). Telemonitoring based service redesign for the management of uncontrolled hypertension: multicentre randomised controlled trial. *BMJ*. 346: f3030 <https://doi.org/10.1136/bmj.f3030>

[O2] Hanley J, Ure J, Pagliari C, Sheikh A, McKinstry B (2013). Experiences of patients and professionals participating in the HITS home blood pressure telemonitoring trial: a qualitative study. *BMJ Open*. 3:e002671. <https://doi.org/10.1136/bmjopen-2013-002671>

[O3] Hanley J, Fairbrother P, Krishan A, McCloughan L, Padfield P, Paterson M, Pinnock P, Sheikh A, Sudlow C, Todd A, McKinstry B (2015). Mixed methods feasibility study for a trial of blood pressure telemonitoring for people who have had stroke/transient ischaemic attack (TIA). *Trials*. 16:117 <https://doi.org/10.1186/s13063-015-0628-y>

[O4] Wild S, Hanley J, Lewis S, McKnight J, McCloughan L, Padfield P, Parker RA, Paterson M, Pinnock H, Sheikh A, McKinstry B (2016). Supported Telemonitoring and Glycemic Control in People with Type 2 Diabetes: The Telescot Diabetes Pragmatic Multicenter Randomized Controlled Trial. *PLoS Med*. 13(7): e1002098. <https://doi.org/10.1371/journal.pmed.1002098>

Submitted to REF2.

[O5] Hammersley V, Parker R, Paterson M, Hanley J, Pinnock H, Padfield P, Stoddart A, Park HG, Sheikh A, McKinstry BH (2020). Telemonitoring at scale for hypertension in primary care: An implementation study. *PLoS Med*. 17(6): e1003124 <https://doi.org/10.1371/journal.pmed.1003124>

[O6] Sheppard JP, Martin U, Gill P, Stevens R, Hobbs R; Mant J, Godwin M, **Hanley J**, McKinstry B, Myers M, Nunan D, McManus RJ (2018). Prospective external validation of the Predicting Out-of-Office Blood Pressure (PROOF-BP) strategy for triaging ambulatory monitoring in the diagnosis and management of hypertension: observational cohort study. *BMJ*. 361: k2478 <https://doi.org/10.1136/bmj.k2478> **Submitted to REF2**.

[G1] BUPA Foundation: Sharing Responsibility: The public health impact of a nurse-led telemetric home blood pressure monitoring service. Hanley J (lead), McKinstry B, Wild, S, Padfield P. February 2008 – March 2011. £233,524. Sponsor Edinburgh Napier University (Edinburgh Napier University ref E3161) ISRCTN72614272

[G2] Chief Scientist Office ARPG/07/03 Telemetric supported self-monitoring of long-term conditions. McKinstry B, Sheikh A, Hanley J, Pinnock H, Wild S, Forrest J, Lewis S, MacNee W, Padfield P, Pagliari C, McKnight J, McClusky C, Sudlow C. June 2008 – July 2014. £983,330. Sponsor NHS Lothian.

[G3] Chief Scientist Office CZH/4/1135. Scale-up BP: Implementing evidence-based hypertension research at scale. McKinstry B, Parker R, Pinnock H, Hanley J (lead at Edinburgh Napier), Steventon A, Padfield P, Stoddart A. 1 Nov 2015 - 31 Dec 2017. £244,896 Sponsor University of Edinburgh. (Edinburgh Napier University reference R1072)

[G4] British Heart Foundation: Who benefits from cardiovascular risk reduction programmes? Building a Scottish observatory to measure the impact of blood pressure (BP) telemonitoring and future cardiovascular risk reduction interventions. Hanley J, Atherton I, Neubeck L, Parker R, McKinstry B, Guthrie B. Sep 2020 - Aug 2023. £192,845. Sponsor Edinburgh Napier University (Edinburgh Napier University ref R1777)

4. Details of the impact (indicative maximum 750 words)

This research has four key areas of impact: 1) Improved patient care through national service redevelopment in Scotland with BP telemonitoring now reaching over 14,000 people (patients) 2) supporting remote health care delivery in response to covid-19, 3) International influence on clinical guidance and service development in the United States, Canada, Europe, Asia and Japan and 4) Improved identification of patients who would benefit from remote BP monitoring.

1) National Service Redevelopment in Scotland

The Scale Up BP pilot **[O5]** led to 72 GP practices in NHS Lothian adopting the system, offering BP telemonitoring with primary care support. One practice nurse commented "*it increases patients' awareness of hypertension and what causes it*" and a GP "*I think the best part of this is that I don't have to go anywhere looking for them [...] and I can assess them and compare with the previous ones*". Patients involved in the pilot commented "*it's good because it makes you realise [...] BP's a sort of hidden thing normally*" and "*it was more convenient and also I think more realistic*". By November 2020 Scale up BP was being used by 14,464 people (patients) in 430 GP practices across 11 of the 15 Scottish Health Boards **[C1]**. The development was awarded the Clinical Improvement Award: Public Health and Prevention at the UK General Practice Awards in December 2019 **[C2]** and was shortlisted for the prestigious British Medical Journal (BMJ) awards **[C2]**.

The research findings **[O1-O5]** informed Scottish Healthcare Policy. The Scottish Government's Digital Health and Care Strategy, published in 2018, referenced the body of research as an influence on its findings, and the future direction of Scottish Healthcare **[C3]**. The report states "*A number of successes have been achieved in specific areas, including using technology enabled care (TEC) in prevention and early intervention (for example, in the management of hypertension [...]) The plan recommends that: Evidence based technology enabled health and care (TEC, including telehealth) be more broadly implemented at scale across Scotland [...]) Initial use cases should include care and management of common chronic conditions such as diabetes and hypertension: Building upon the substantial success of these latter two' [C3]*".

The findings also influenced The Scottish Government's 2018 Supporting & Empowering Scotland's Citizens National Action Plan for Technology Enabled Care **[C4]**. This inquiry researched how best to deal with hypertension across Scotland and cites Scale up BP as an

important case study for how BP can be better controlled. It notes *“This inquiry recommends that high blood pressure task force prioritises the availability and adoption at scale of self-monitoring and self-management of high blood pressure supported by telemonitoring”* [C4].

Scale Up BP was adopted by the Digital Health and Care Strategies implementation board in 2018 as a GBP1million service transformation programme. The 2019 – 2021 implementation strategy was launched in May 2019 [C5] and has a target of being adopted by 50% of GP practices and to reach 20,000 patients by 2021. This is projected to reduce major cardiovascular events by 12% per year and reduce routine primary care visits for BP checks by 24% per year. Dr Hanley has been funded by The British Heart Foundation to lead a study to develop methods to measure this improvement [G4] with results due in 2023.

2) Supporting remote health care delivery in response to covid-19

Scale Up BP provides the tools for remote care delivery for people with hypertension. Figures from NHS Lothian show that there was a huge increase in use of this service in the wake of covid-19 from 86 people (patients) in January 2020 to 461 people (patients) in October 2020 [C1]. One GP said *“It’s even more appropriate in light of Covid-19 and we are pushing on to recruit more people. Knowing that we can prevent more heart attacks and strokes this way is a real plus factor, and our patients like feeling supported without needing lots of trips to the health centre”* [C6].

3) International Influence on Clinical Practice and Guidance

In the United States, O1 was included in the systematic review underpinning the 2017 American College of Cardiology/American Heart Association (AHA) clinical guideline on hypertension [C7]. It was also directly cited 4 times in AHA statements recommending the use of mobile health for cardiovascular disease prevention and BP measurement [C7]. O2 was cited in a policy statement from the AHA about implementing telehealth in cardiovascular and stroke care [C7]. These guidelines, scientific and policy statements have led to the current AHA clinical programme ‘Target BP’ [C7], which recommends BP self-monitoring and telemonitoring across the United States. In 2019, these approaches had been adopted by over 1,000 healthcare providers in the country, covering almost 9million patients with hypertension across 44 states [C7].

The trials have also been cited 8 times in other international guidelines. These include the 2016 pan Asian consensus guideline on hypertension management [O1]; the 2019 Japanese guideline on Management of Hypertension [O1, O3] and the 2020 Canadian 2020 comprehensive guideline on the diagnosis, risk assessment and treatment of hypertension [C7].

Additionally, patient level data from O1, O3 and O4 (758 patients) was shared with a systematic review team from University of Oxford, and the subsequent reviews recommending home BP monitoring and Telemonitoring are cited in the 2018 European Cardiology Society guideline on arterial hypertension, and the 2020 US Surgeon General’s Call to Action to Control Hypertension [C8].

Proof-BP, the online hypertension screening tool developed in O6, which improves the identification of people who may benefit from further assessment of their BP, has been made freely available online. It has very recently been recommended by the US Preventive Service Task Force to improve the identification of people with masked hypertension (a high-risk group of 3-5% of the adult population who have low BP when measured in the surgery but have high underlying BP) [C9].

5. Sources to corroborate the impact (indicative maximum of 10 references)

[C1] Scale up BP users

- Email and excel file from Project Support Officer, Programme Management Services (PgMS), Strategy, Performance and Service Transformation, NHS National Services Scotland showing Scotland-wide patient recruitment since April 2019

- Email and word file from Project Team Manager, Long Term Conditions and Remote Care Pathways, showing patient recruitment in Lothian since 2016.

[C2] Award Nominations for Scale Up BP

- UK General Practice Award Prize-winners 2019:
<https://www.generalpracticeawards.com/winners/winners-2019/>
- BMJ awards 2020 shortlist: <https://www.bmj.com/content/369/bmj.m1215>

[C3] Report of Scottish Parliamentary Cross Party Group on Hypertension

<https://www.chss.org.uk/documents/2019/01/beating-high-blood-pressure-scotlands-silent-killer-pdf.pdf>

[C4] Scottish Government (2018) Digital Health and Care in Scotland: Report of the external expert panel:

<https://www.gov.scot/publications/digital-health-care-scotland-report-external-expert-panel>

[C5] National roll out of Scale Up BP: <https://tec.scot/bp-scale-up>

[C6] GP quote from an article in 'The Scotsman' Newspaper 19/06/2020

<https://www.scotsman.com/health/home-blood-pressure-test-could-ease-gp-demand-and-boost-health-2889553>

[C7] International clinical policy and guidance referencing O1- O5

<https://edinburghnapier.padlet.org/janethanely/h4fdutzco3b4h7h9>

[C8] International Clinical policy and guidance citing the systematic review which included patient level data from 758 patients in trials O1, O3 and O4

<https://edinburghnapier.padlet.org/janethanely/s98epeoh29p42lj7>

[C9] Evidence Synthesis Number 197: Screening for Hypertension in Adults: A Systematic Evidence Review for the U.S. Preventive Services Task Force

https://www.uspreventiveservicestaskforce.org/home/getfilebytoken/eJK9TawoTG_A93UfeP8k5 Proof BP (<https://sentry.phc.ox.ac.uk/proof-bp/>) is recommended on p43.